WHAT A UNIVERSITY SHOULD DO FOR ITS STUDENTS

(Extracts from the Inaugural Address on February 22, 1928, of Dr. M. Lyle Spencer, President of the University of Washington, Seattle)

. . . . . It is a solemn, a sacred duty, this assumption of authority to direct the destinies, even for four years, of more than seven thousand young men and women. No man can have a higher or more consecrated mission than this; for the lives of the youth of our state are dearer to us than all the treasure America possesses. One stands in awe at the responsibility and the latent possibilities. Generations are unborn whose lives shall be affected by the character of the education we offer on our campus, and the very destiny of our state may be altered by our varying curricula. We have reason, therefore, to regard this hour as sacred. . . .

No university is a university other than in name unless the spirit of research, the ardent quest for the unknown, permeates its faculty. The staff of a real university is, to use the fine phrase of ex-President Eliot, "a guild of scholars," mutually encouraging and supporting each other in fired and emulous devotion to the discovery of truth. The active spirit of research in a university keeps a faculty young and virile. It inspires and disciplines those chosen few who are to be the intellectual leaders of society. And save for the rare individual who is weaned away from human sympathies and contacts by his study or his laboratory, it vitalizes and vivifies the teaching of even the most elementary courses.

The University of Washington would fail in its contribution to society if it did not meet the pressures for advanced study as they present themselves. It must accept its full share in the work of training research men in the fields of pure and applied knowledge, and of preparing men for teaching in institutions of higher learning. We must not fail the commonwealth or the nation in either of these obligations, for in the faithful discharge of them is implied the perpetuity and advance of American civilization. Our University must aspire, therefore, to a well-balanced graduate school.

On the other hand, there are certain fields of research in which special and prior responsibility rests upon us by virtue of our location, and in which the scientific world at large has particular claims upon us. Our distinctive province for research must logically be in those fields where natural advantages accrue to us by reason of our geographical location and where greatest returns, both spiritual and material, may be had for those who are supporting us with their tax monies. Among these fields may be enumerated: Northwest history, Northwest anthropology, Oriental history and Oriental

trade, international relations, the geology and biology of the Northwest and of Alaska, hydraulic and electrical engineering, aeronautics, fisheries, and forestry. . . .

One feels a need for this most uncommon trait called common sense in solving many of the problems of undergraduate education. Among these may be noted our phenomenal increase in enrollment, the attendant criticism of mass production in education, the continuing cry of over-emphasis on athletics, and the equally old questioning as to the place of vocational education in the curriculum. All these problems are pressing on us at the University of Washington. And while one naturally hesitates to postulate any general solution, there are a few broad principles that may be laid down for this university.

One of these principles relates to our gain in under-graduate attendance. We have this year the largest enrollment in our history, and one of the major increases among the universities of the West. Despite the popular fear regarding the number of students going to college, and the consequent occasional threat to limit attendance, common sense tells us we are going to provide an education for every son and daughter in the State of Washington who wants it sincerely and who has the mental capacity to receive it. There may be complaints—we expect them always—but education will be provided by the State of Washington for those who deserve it, no matter in what numbers the students come.

Common sense, however, tells us that we have been giving the stamp of a university education to too many youths whose mental capacity has not reached beyond the freshman or sophomore year. We must plan our university curriculum—and that promptly—to take care of those who cannot continue beyond the first or second year, or who are not entitled to do so; and then we must see to it that such students, having been accurately appraised, stop there. To every boy or girl an opportunity, but to no boy or girl an opportunity beyond his deserts.

When this is done, we shall not be bothered with cries of mass production in education, about which so much loose and sometimes meaningless talk has been made. Mere numbers do not constitute mass production in the sense that the term is applied to automobiles or furniture or harvesting machines. Thousands may be educated as readily as hundreds, and as individually. More individually indeed, for where numbers are, the opportunities for clash of mind upon mind and for diversity of choice both of instructors and subjects are the greater. And where these conditions exist, the entire tendency is away from uniformity, which is what mass production implies.

Common sense tells us, too, that our University, if it expects to maintain its place of prestige in the state—if, indeed, it expects to exist at all—must represent the life of the commonwealth and must minister to that life. President Butler of Columbia made the following significant statement

something more than thirty years ago: "When the universities in any country cease to be in close touch with the social life and institutions of the people, and fail to yield to the efforts of those who would readjust them, their days of influence are numbered." Interpreted to apply to our situation in the State of Washington, this means that we must adjust our curriculum to our students, not our students to our curriculum.

If this premise be sound—and I think there is none who will deny it—it gives a rock basis on which to build a structure for undergraduate education that will meet the needs of the youth of our state. These needs may be summarized under four heads; health, economic and vocational guidance, citizenship, and knowledge and appreciation of the things of the spirit. Necessity for brevity prevents me from doing more than summarize reasons for these four points.

I put health first because it is fundamental to success and happiness in life. We may garner the wisdom of the ages, but if we have not health, our lives become a curse to ourselves and oftentimes a menace to those of others. Before graduation, therefore, every student should be taught by skilled instructors how to keep in sound physical condition. He should learn the value of health. He should know not only the worth of exercise, but the right kind of exercise for himself individually; and he should learn enough about diet, foods, and balanced rations to protect himself on the one hand from malnutrition, and on the other from dietary excesses later when he gets into the maelstrom of modern business. Nor should I consider his health education complete until he has been given the scientific facts of sex and sex life that will promise him happiness in marriage. The ignorance of these fundamental matters that has blasted the lives of otherwise highly educated men and women is appalling.

Second, every student should be given economic and vocational guidance. This is of two kinds. One would enable the future citizen to take care of his personal business affairs, no matter what his vocation might be. It would acquaint him with the details of buying real estate, teach him to distinguish between sound investments and spurious speculative schemes, instruct him in the value of life insurance and wills, inform him about loans, mortgages and budgets, and give him the fundamentals of simple banking practice. Too few college and university men know how to manage their personal finances. Too many have had their lives wrecked because of the trust in the promises of visionary stock promoters. And one of the duties this University owes to its graduates is to provide practical business education that will enable them to protect themselves and their families financially.

Vocational guidance in the sense I mean it, does not concern itself alone with training for a specific profession, but with personal guidance of the student into the field where he will be more likely to attain success. Too many of our graduates leave the University merely seeking a job. They

do not know whether they want to teach, sell bonds, or go into manufacturing, or whether they are fitted for any of these vocations. These fields, however, are widely separate. A different type of mind is necessary for success in each. And one of our greatest needs is broadly trained educators who can direct students so that they will not have to spend some of the best years of their lives after leaving the University in floundering around while determining their life work.

I may add that I favor business and professional education. Every male student ought to be able to determine before finishing his junior year the precise vocation into which he is going. The curricula of many of our professional schools, however, need revision, with a view to providing more horizon-widening studies and making Profit and Service their aims, to correspond with the accepted purpose of Scholarship and Service in the colleges of arts and sciences. Men who graduate from the professional schools, if they possess the highest type of mind, find always that they attain their fullest success in business and their greatest happiness in life as much by the horizons of information they have as by the technical training received in specialized fields.

One other interpolation needs to be made under the topic of professional training. This, that the schools on which we should lay our greatest emphasis at the University of Washington are those that fit men for industries or professions in which this state has natural advantages or particular need. Forestry, fisheries, engineering, and education may be cited as illustrations. Too many institutions of learning make the mistake of seeking prestige abroad instead of educating at home.

My third point, citizenship, is obvious enough not to necessitate argument before a thoughtful audience. The majority of our population is insensible to the needs of a conscientious, educated citizenship. Our commonwealth is suffering accordingly. Our laws are violated by those who make them and those responsible for their execution. Many of our highest public officers are chosen by a depressingly small minority of the electorate; and we not only have hundreds of millions of dollars voted for civic and state enterprises, but problems of the greatest importance determined by an interested and often prejudiced few.

What we need in undergraduate education is continuing stress, not alone on forms and methods of government, but on the personal responsibility of the individual for righteous government and direction of the affairs of our state. Not until our students are educated to feel themselves an integral part of government will they have the personal interest in its direction and assume the active leadership that we need from them if our state is to take its rightful place in the affairs of our nation.

My fourth point, knowledge of the things of the spirit, is tuition in what is known in a more or less hazy way as culture, a shibboleth too often used to conceal academic aimlessness. Education is education, and is

worth while, only when it preserves the useful acquisitions of the race. The experiences and the accomplishments of the past are not of value to us except when they can be made useful in the future. A past that has no lessons worth while, has no place in education.

Value does not reside, however, in the mere act of making a living, in eating, drinking, housing ourselves comfortably, and in securing monetary gain. The highest values are in the things of the spirit. We work in order to have leisure; and according as we spend that leisure we have our purest pleasures and our greatest happiness in life, for it is in our leisure hours that we enjoy most fully our spiritual possessions. We need education, therefore, for avocation, for the mental horizons that give breadth of vision and richness of life. . . .

We are not paying sufficient salaries to retain our best men, many of whom, for this reason alone, we have lost in recent years. Yet retention of our strong men is essential to the power of our University; for where great teachers are, great students come and great citizens are graduated. . . .

. . . Letters of the alphabet after a name are meaningless unless followed by the magic letters of efficiency—O. K.

. . . Curriculum makers may use less sophistry in justifying some of their courses of study. It is extremely important to develop a love of learning, a taste for scholarly things, an appreciation of great books, a thirst for knowledge, and a humble attitude toward things of the mind. Great scholars are not always great teachers, but great teachers must first be great scholars. Solid buildings rest upon firm foundations.

—*Journal of Education* (Wisconsin).

THE BRIDGE BUILDER

The bridge builder who has spent a life-time in building bridges is sent for, to put up a new and important communicating bridge.

The bridge builder, having been duly commissioned, draws up plans and specifications for the bridge to be built—he has been doing this all his life, and is widely known for the well-built and durable bridges he has put up before. He knows the meaning, the use, the necessity of every bolt that goes into the structure.

The plans are submitted to the powers-that-be for approval of the specifications and for furnishing of materials, supplies, and help.

In the meantime the bridge builder proceeds to the distant site, to rush forward excavation and building of the piers on which the bridge is to be placed.

Finally materials come forward with action on the specifications showing that many large cuts had been made in what the bridge builder had clearly stated was essential to erect a proper and trustworthy bridge. A third of the bolts, and pieces of steel here and there—the use of which was not clear—were blue-pencilled.

The bridge builder protests but is told that it cannot be helped—that he is to go ahead and accomplish what he can.

Some months later the powers-that-be visit the site to inspect the completed bridge, only to find it still incomplete and barely passable on an improvised road-bed. They return to denounce the bridge builder as incompetent, and unable to meet the ordinary demands of his work, and may even go so far as to declaim on the uselessness of engineers in general.

—Charles Fuller Baker, (Written in 1925)

PRACTICAL DIRECTIONS FOR COFFEE PLANTING[1]

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(Revised by CHARLES FULLER BAKER)

The receipt, almost daily, by the College of Agriculture of letters from the different provinces of the Philippines and from foreign countries asking for information and advice in regard to the growing of coffee suggested the preparation of this article. The directions here given are written primarily for Filipino growers. They are based upon the experience of practical growers visited outside the College and on 1916–1926 data obtained from the work of the Experiment Station in the College of Agriculture.

The purpose of this publication is to give directions that will assist an ordinary coffee grower in obtaining the "maximum production of quality coffee consistent with the smallest outlay of money and labor". It is impossible to give specific instruction on every point, because conditions and cultivation methods on the different farms vary in detail of practice. The grower, therefore, will use his own judgment in applying these instructions to suit his particular conditions.

In the Philippines, land can be secured: (1) by direct purchase or leasing it from the government, (2) by applying for homestead, (3) by buying it from a private holder, and (4) by renting it from a land owner.

POINTS TO BE CONSIDERED IN SELECTING LAND FOR A COFFEE PLANTATION

Good land. Most of the forest land in the Philippines is well adapted to coffee. A suitable soil should be deep, friable, rich in humus, deep black in color with a good drainage. Sandy, clayey, or calcareous soils should be avoided. Virgin forest land is the best. Coffee will not grow on salty soils.

Elevation. Different varieties of coffee require different elevations. The best elevation depends upon the types of coffee to be grown. The Robusta and Liberica grow from sea level to an altitude of about 900 meters. Arabica grows best at higher levels. Coffee should never be planted near the sea without windbreaks. It has been reported that the strong sea breeze blows off many flowers and consequently the yield is decreased.

[1] Experiment Station contribution No. 532. Received for publication January 17, 1928. This article was issued in October, 1926, in mimeograph as College of Agriculture Circular No. 10.

Shelter from wind. Shelter from wind is indispensable, for coffee will not thrive well in a windy place. A sheltered valley is a good location for coffee growing. One's neighbor's experience will help in locating a coffee plantation. Natural barriers are to be preferred.

Shelter from wash. As a general rule a moderately gentle slope on the base of a hill may be selected. Gently undulating table land is the most desirable. Such a lay of land facilitates working and any alluvial deposits remaining on it add to the richness of the soil. A very flat land is undesirable; it retains too much moisture. Also very steep land is objectionable as there will be heavy erosion.

Proximity to river. The coffee plantation must be near a running stream. Watering the young plants in the nursery and preparing the berries for market require much water. But the plantation must not be so close to the banks of the stream as to be flooded during the rainy season.

Climate. A "sub-temperate climate within the tropics" is the most suitable climate for coffee. The climate in Batangas, Bukidnon, Iloilo, and Mountain provinces make these the best regions in the Philippines for planting coffee. The annual rainfall should not be less than 178 cm. It should be supplied as evenly as possible throughout the year. Prolonged droughts are fatal to coffee, but too great a supply of water should be avoided.

VARIETIES OF COMMERCIAL COFFEE

At present there are three groups of commercial coffee grown in the Philippines. These are: (1) Arabica, (2) Robusta, (3) Liberica, with their allied types. These groups vary greatly according to climatic and soil requirements as well as in their resistance to diseases and pests. For this reason it is advisable to describe each group separately.

Arabica. Owing to its superior flavor and aroma, Arabicu is the highest priced commercial coffee. It is the only coffee in the Philippines suitable for export. The objection to this variety is that it is highly susceptible to coffee blight, *Hemileia vastatrix* B. et Br. Experiments in the College of Agriculture show that altitude alone cannot render Arabica resistant to *Hemileia.* Arabica cannot be profitably grown at lower elevations. Arabica trees planted at 450 meters above sea level were badly attacked by the rust. This variety may be planted only at high altitudes. It should not be planted in places where the rainy season coincides with the plant's flowering time. This type flowers from December to January. The harvesting of the berries comes during November, January, February, and March. Arabica requires a rich, deep, and friable soil. Under ordinary conditions, it gives a yield of about 250 to 400 kilograms of coffee to the hectare of 1600 trees, planted 2.5 by 2.5 meters.

Robusta. This group has the poorest flavor of all the coffees tried in the College of Agriculture. It thrives at an altitude between 200 to 600 meters above sea level. It may be grown at lower levels, but not profitably. This

variety requires soil that is rich and friable and has an abundance of organic matter. It is very particular about soil. An annual rainfall of 2 to 2.5 meters of equal distribution throughout the year is required. Robusta is very sensitive to heat. If the land becomes dry during the flowering season a great part of the crop is lost. This variety flowers from December to March and the harvesting of the berries comes during November, December, January, February, March, and April. The berries of Robusta vary greatly in size. They ripen more slowly at high altitudes. Many branches dry out after the harvesting season. The trees yield three years from the time they are transplanted in the field. Under favorable conditions Robusta gives a yield of from 700 to 900 kilograms of coffee to the hectare of 1,111 trees, planted 3 by 3 meters. Authorities on coffee call attention to the fact that Robusta gives excellent satisfaction as a catch crop under young rubber trees. The coffee trees are cut down before the rubber trees begin producing. Many coconut planters in Laguna plant Robusta under old coconut trees.

Liberica. The Liberica coffees, including Excelsa, can be planted from sea level to 300 meters above sea level. Excelsa can be grown at very much higher altitudes. Liberian types are quite drought resistant and produce vigorous plants. They resist the attacks of nematodes and *Hemileia vastatrix* B. et Br. They can be grown where the dry season extends to several months of the year and can grow on heavy soils. They begin to yield five years from the date of transplanting in the field. The flowering season takes place from March to July and harvesting of the berries comes during February, March, and April. Better production can be expected with 1.2 meters of evenly distributed annual rainfall. The yields of Liberian and Excelsa varieties vary from 400 to 500 kilograms of coffee to the hectare of 500 trees, planted 4 by 5 meters. The coffee planters in Batangas and Laguna prefer Excelsa to Robusta because of its wide adaptability and greater resistance to drought, diseases, and pests. Liberian coffees require less care than either Arabica or Robusta.

VARIETY TO PLANT

Every coffee planter should plant only the variety that produces the best quality of berry in the region where his plantation is. The question as to which type of coffee is adapted to a locality requires much attention. In establishing a coffee plantation in a place where coffee is already growing, one should study the local varieties grown and try to find the best and most profitable type. Examine the varieties of coffee growing in the neighboring towns and barrios where the conditions of soil, climate, altitudes, etc. are similar to the proposed plantation. Only one variety of coffee should be planted. Different varieties when grown in one plantation involve much work, for each type of the coffee mentioned above requires different treatment in the field and in preparing the product for the market. In very large

plantations covering different altitudes, more than one variety may be planted.

SEED SELECTION AND PREPARATION OF SEEDS FOR PLANTING

Seeds for planting should be picked at the end of the harvesting season and only from the best yielders and healthiest trees. The berries should be well ripened and large and free from any signs of disease. Plant only fresh and selected seeds. All pea-bean shaped beans should be discarded. It is advisable to pulp the seeds with a hand-pulper. The slimy mass covering the beans can be removed by rubbing them with lime or fine sand and washing the seeds thoroughly with water. All beans that float on the water during the washing process should be discarded. The washed seeds can be dried in the shade. The seeds selected for planting should not be kept longer than five months or they will lose their vitality.

For several reasons it is not advisable to buy seed for commercial planting from coffee dealers in other countries. Commercial coffee is usually dried artificially at a high temperature. In most cases the embryos are killed in the fermenting process. The value of imported seeds as stock is not reliable. They are often harvested from unselected trees in the plantation and they may carry disease. The plants from these seeds have to be acclimatized. Seeds for planting should be purchased only from reliable sources.

SEED BEDS AND NURSERY

Location. A cool, sheltered and a well drained location should be selected for a seed bed. The soil should be virgin but not richer than that of the plantation where the seedlings will be permanently planted. Seedlings nursed in a very rich seed bed suffer much when transplanted to a poorer soil. The seed bed should be near a good supply of water and close to the planter's house. The nursery requires the planter's personal attention. In large coffee estates, nurseries can be located in different parts of the plantation, say one nursery for every five-hectare plantation. When coffee is not planted on a large scale, seeds may be grown in seed boxes. Kerosene boxes cut lengthwise into halves make good germinating boxes. The germinating soil should contain equal proportions of well rotted leaf mold, fine sand and ordinary garden soil. Small holes should be made in the bottom of the boxes and a small amount of fine gravel put in for drainage. Then add the soil mixture of well rotted leaf mold, fine sand, and garden soil. After the seed is planted the boxes should be kept above the ground on a bamboo or wooden platform. In large scale planting, the seed bed method is more practical than the seed boxes.

Preparation. The seed beds should be prepared with the utmost care. Cut all brush and grass, then dig up the roots and pile them upon the beds, where they may be left until dry enough to burn. Some planters do not burn the trash but remove it from the beds. After cleaning, the beds are

dug up with a spade to a depth of about 30 centimeters. They may also be plowed several times. After spading the beds, the addition of a good supply of well decayed manure or compost is often advisable. After the soil is thoroughly prepared, fertilized if need be, beds of one meter wide and as long as desired, leaving a path 50 centimeters wide between them, are made. Long beds are preferable. The soil in the beds should be well pulverized by repeatedly working it over with a spading fork or hoe and the surface should be made smooth with a rake. The beds are often raised slightly above the general surface of the ground for drainage. After the beds are well worked out and smoothed, divide them with a planting line crosswise into rows about 15 centimeters apart. Make a groove four to five centimeters deep along the line.

Planting the seed. Plant the unhulled seeds about 2 to 2.5 centimeters apart in the grooves. Cover them with finely pulverized soil. Some planters do not make grooves on the beds. They just place the seeds on the smooth surface of the bed, about 10 centimeters apart and then press them in lightly with a finger to a depth of 3 to 5 centimeters. After the seeds are planted, the beds may be covered with rice straw or cogon grass (*Imperata cylindrica* var *Koenigii* (Retz) Benth) to prevent the rain from uncovering the seeds and to keep the earth moist and free from weeds. Thorough watering should follow planting. Thereafter, watering should be done late in the afternoon and as often as necessary. The seeds will germinate in from four to eight weeks.

Shading the beds. To protect the seed beds from the intense heat of the sun, hard rain, and rapid evaporation of moisture, they should be provided with either natural or artificial shade. The simplest method of shading the seed beds is to construct a bamboo framework (*balag*) resting upon bamboo or wooden posts, high enough to permit the nursery man to work freely under the shed. On the top of the framework lay palm leaves or cogon grass, allowing a little sunlight to fall on to the beds. The shading material should be tied securely to the framework to prevent it from being blown off by the wind. Some farmers do not use palm leaves or cogon grass for shading the beds, but, instead, plant some climbing plants, such as upo, (*Lagenaria leucantha* (Duch.) Rusby), patola (*Luffa acutangula* (Linn.) Roxb.) batao (*Dolichos lablab* Linn.) and the like so they will cover the framework. The climbing plants should be planted early enough so that the shade will be ready by the time the coffee seeds are planted. The shade should not be too dense. When the seedlings have developed two or four leaves they are ready for transplanting in the nursery beds.

Planting in the nursery beds. Some coffee planters transplant the seedlings from the seed beds to a nursery bed. This operation checks the growth of the seedlings. It hardens the young wood and makes the young plants better able to resist the attack of insects and unfavorable weather. When the nursery beds are used, the young seedlings are carefully trans-

planted in rows 20 to 30 centimeters apart using a sharpened bamboo stick or trowel to dig them up and to plant them. The transplanting should be done during cloudy weather or late in the afternoon. In transplanting, care should be taken not to double up the tap roots. The seedlings in the nursery beds should be less shaded than in the seed beds. The beds must be kept well weeded at all times and watered as often as necessary. The seedlings should be left in the nursery beds until they are strong enough to withstand conditions in the plantation.

Some farmers make use of the young plants which spring up around the old coffee trees in the plantation for nursery seedlings. These seedlings are from ripe berries which have been shaken off by the wind and from overripe ones which have fallen between pickings. Such plants require much attention before they can be planted out in the field. Their merit as stock is uncertain.

Transplanting to the field. When the seedlings have attained a height of 35 to 45 centimeters or have six or seven pairs of leaves they are ready for transplanting to the permanent plantation. Some planters prefer to transplant large seedlings, after they are about eighteen months old. In the College of Agriculture, it was found that the younger the seedlings the less they suffer in transplanting. Selection of the seedlings should be rigid during the process of transplanting. Only the most vigorous seedlings should be used for planting in the field. Large seedlings to be shipped to some distance, should be dug up with a ball of earth with their roots. The balled seedlings can then be packed in a box or banana sheath. Young seedlings when transplanted are just pulled up without soil and then packed in bunches. Sometimes old seedlings when transported to some distance are cut off about 30 centimeters above the ground. The remaining leaves are cut to about one-half their size, after the seedlings are transplanted in the field. Care must be taken in transplanting not to injure the roots. The best time for transplanting from the nursery to the permanent plantation is the rainy season.

PREPARATION OF THE LAND

In establishing and running a coffee plantation, the new coffee grower will do well to follow the local methods of preparing and cultivating land. These local methods followed by the common farmers may have certain faults from the viewpoint of a trained coffee grower, but corrections can be made only after long and careful observations. The utmost care should be taken in the preparation of the land. Errors made in this work will be very difficult to correct and will mean a great loss of time, money, and labor.

The first step in the preparation of the land is the clearing of the forest. When timber land is to be used for the plantation, some farmers clear it by cutting down all undergrowth and felling all the trees and then burning

over the area. This system of burning the clearings can not be recommended where there is a fear of loss of humus.

Other planters in clearing the forest leave the larger trees standing to furnish immediate shade for the young coffee plants. On hilly land the trees at the top of the plantation are left to act as windbreaks and to prevent washing. Palm trees, such as buri (*Corypha elata* Roxb.), coconut (*Cocos nucifera* Linn.), or caong (*Arenga pinnata* Wurmb.) Merr.) should not be left standing in the plantation among the coffee trees as their falling leaves may cause great damage. Many planters object to leaving large trees for immediate shade in the plantation; they claim (*a*) not all trees in the forest are suitable for shade trees, (*b*) the shade trees will not be at equal distances apart among the coffee plants, and (*c*) the kind of shade needed by the coffee plants is frequently not the kind of shade afforded by the forest trees left uncut.

Another method employed in clearing forest land is to cut down the trees, then lop them before they get seasoned and tough. The wood, leaves, and litter are left on the ground to decay. This practice will preserve the humus, but it will take two to three or more years for the cut trees and branches to decay.

In preparing the soil for the new plantation under the intensive cultivation methods, the forest is cut down as in the *caiñgin* method of clearing a field and then the wood, branches, leaves, and litter are burned during summer. The whole place is then planted to upland rice. The cuttings for shade trees are planted at the same time as rice. Madre de cacao (*Gliricidia sepium* (Jacq.) Steud.) cuttings about one meter in length when planted six meters apart will make satisfactory temporary shade. The best time for planting these is from May to June. After the first two crops of rice are harvested, the madre de cacao will be ready to afford the necessary shade for coffee seedlings. In the coffee districts of Lipa, Batangas, after the field is prepared, the madre de cacao seeds are drilled in or planted like corn in rows about 1.25 meters apart.

Cogon land may be used for a coffee plantation. It should be plowed several times and then planted to some kind of heavy growth legumes. The legumes must be planted one year before the coffee is to be set in the field. Never plant coffee as long as there is cogon grass on the land. The legumes must be plowed under. This will improve the mechanical texture of the soil. Then plant the madre de cacao seeds in rows. Constant weeding is necessary. When the madre de cacao seedlings are large enough to furnish the shade, the coffee seedlings should be transplanted.

Where there are *aparceros* (tenants) the land may be leased to them for a certain length of time. If the terms are satisfactory to the *aparceros*, they will clear and farm the land in a most satisfactory manner. Generally, they plant rice (*Oryza sativa* Linn.), corn (*Zea mays* Linn.), root crops, banana (*Musa sapientum* Linn.), mungo (*Phaseolus aureus* Roxb.) and

other legumes between the coffee trees. As soon as the coffee trees begin to bear, the contract with the *aparceros* may be renewed. The conditions of the contract depend to a great extent on the locality. Some of the plantations in the College of Agriculture are worked by the *aparcero* system.

DISTANCING, LINING, HOLING, AND PLANTING

Distance of planting. The distance of planting depends upon: (*a*) variety planted; (*b*) richness of soil; and (*c*) climate. In exposed plantations, close planting is advisable. Where the soil is rich and the climate is warm and humid, wider planting is good. In the College of Agriculture Experiment Station Farm, the distance of planting and the number of plants contained in a hectare are as follows:

Groups	*Distance*	*Number of trees*
Arabica coffee.....	2.5×2.5 meters.....	1600
Robusta coffee.....	3.0×3.0 "	1111
Liberica coffee.....	4.0×5.0 "	500

The planting was done in squares. It has been the experience with the College of Agriculture plantations that trees planted too close together grow slender and are more attacked by cryptogamous diseases than when farther apart. Also, when light and air are not sufficient the crop is decreased. Mr. Leon Katigbak, a coffee grower in Lipa, Batangas, recommends planting Robusta at 3.75 by 3.75 meters.

Lining. Coffee plantations can be lined by using a rope or planting line to which pieces of white cloth are securely tied at the distances apart at which one desires to set the coffee plants. The planting line, handled by two persons, one at each end, should be stretched across the plantation and tied at each end to a pole. The poles must be at least three meters high. After the line is stretched, the two men drive pegs at each rag on the planting line. A good laborer with an ordinary bolo can prepare about 400 pegs a day. When a row is pegged, the men at the ends of the planting line measure off the distance to the next row with the poles and move the line over. The process is repeated until the whole plantation is pegged. In many plantations, pegs are set by measuring off the distance of planting with a stick cut the right length. Care must be taken in this method to set the pegs in straight lines.

Holing. With a spade dig a hole around each peg. The size of the holes depends upon the nature of the soil. In stiff and poor land large holes are preferred. In good light ground, holes of 45 centimeters cube are sufficient. One man can dig from 40 to 50 holes of 60 centimeters cube in a day. The soil taken from the holes is piled on one side of the hole and should be left until the planting time.

Planting. Planting must be done at the beginning of the rainy season. Never attempt to plant coffee trees during the dry weather. The best

time for most localities in the Philippines has been found to be in May and June. In planting, first fill the hole partially with well rotted leaves or mold which can be gathered near the hole. This light filling is essential and must be done just before the coffee seedling is set in the center of the hole. After the seedling is placed in position, fill up the hole with the soil that was taken from it and carefully press it in around the young plant. Never leave a hollow place around the seedling where water can accumulate. If the seedlings are nursed in bamboo pots, wet the soil in each pot before transplanting. When ready for planting, each pot is split by a sharp blow of a bolo on one side. The pot will separate and the seedling with its roots undisturbed can be at once set in the center of the hole which has been partially filled with well rotted leaves and molds. In planting, care must be taken not to injure the roots. The tap root should not be allowed to become bent, twisted or broken when the seedling is set in the hole. It should go down straight with the stem. If the roots are much injured in planting, it is well to take off some of the lower leaves. The remaining leaves can be reduced to about one-half their size, depending upon the circumstances. After the seedling is planted, the soil should be pressed down firmly around the stem. Sometimes staking the seedlings to prevent too much shaking is done. If dry weather follows the transplanting, watering the young plants is advisable. When the shade is not sufficient at the time the coffee seedlings are planted, temporary shelter of some kind must be provided. Some planters use palm leaves for temporary shade. The leaves are driven firmly into the ground in a slanting position close to the seedlings. When vacancies occur in the plantation, they should be filled in as soon as possible from the seedlings left in the nursery. Seedlings used for replanting must be well-grown and at the same age as the first seedlings planted in the plantation.

SHADE

The question of shade in coffee culture in the Philippines should be given the most careful attention by the planter. The income from a coffee plantation is to a greater or less degree determined by the presence or absence of the shade trees. The shade trees for coffee are beneficial in many respects, provided they are of the right kind and properly situated in the plantation. They conserve the soil moisture, keep down the growth of weeds and grass, prevent erosion, and protect the coffee from the violence of strong wind. Wind is very detrimental to coffee during the blooming period. It is said that coffee trees under shade last longer. Other things being equal, the coffee trees under the right kind of shade yield better crops.

In the Philippines, not all trees are suitable for shade trees. Only quick growers, such as leguminous trees, should be used for shade. The leguminous trees keep the soil cool and enrich it with nitrogen and humus by means of their root nodules and fallen leaves and flowers. In many

places kakauate, or madre de cacao, ipilipil, or Santa Elena (*Leucaena glauca* (Linn.) Benth), and anii (*Erythrina fusca* Lour.) have been found to be the best shade trees. The easiest way to plant shade trees is to grow them first in the nursery. Kakauate and ipilipil when grown from seeds should be planted in nursery beds the same as the coffee seeds. The best time to do this is at the beginning of the rainy season. Some planters use the seedlings of ipil-ipil which spring up around old ipilipil trees. Many planters in Batangas plant madre de cacao seeds just after the land is cleared. The seeds are planted like corn, dropping four to six seeds to the hill at one by one meter. The planting may be done at the same time the rice is planted. At the end of the second year, rice planting is discontinued and the coffee seedlings are planted when the madre de cacao trees are large enough to afford shade. Cuttings of ipilipil and madre de cacao are sometimes planted instead of the seeds. The cuttings can be planted in holes made with crowbars; the soil should be firmed around them very carefully. They should be set in the ground so as not to be easily pulled out.

The density of shade required can be determined only by actual and careful field observations of the local plantations. The shade varies according to locality and elevation. Shade requirement decreases as the altitude increases. It must be remembered that thick shade encourages the coffee trees to grow too tall. Too much shade, even with leguminous trees, should be avoided. Excessive moisture because of thick shade decreases the crop and the coffee trees are exposed to the attack of fungous diseases. It has been advised by many coffee planters that shade trees should be planted rather closely and the unnecessary branches or trees gradually cut out.

The shade trees may be planted according to the following diagrams:

(A)

S c c S c c S c c S c c S c c S c
S c c S c c S c c S c c S c c S c
S c c S c c S c c S c c S c c S c
S c c S c c S c c S c c S c c S c

S = shade trees planted at 6 by 6 meters.
c = coffee trees planted at 3 by 3 meters.

The shade trees may be set alternately at regular distances from the coffee trees, and later every alternate tree be cut out as indicated in the following diagram:

(B)

S $ S $ S $ S $ S $ S
c c c c c c c c c c c
$ S $ S $ S $ S $ S $ S $
c c c c c c c c c c c
S $ S $ S $ S $ S $ S $ S
c c c c c c c c c c c

S = shade trees; c = coffee trees
$ = shade trees cut out.

Mr. Leon Katigbak of Lipa, Batangas, recommended the following scheme:

(C)

X X X X X X X X X X X
c c c c
X X X X X X X X X X X
X X P X X P X X P X X
X X X X X X X X X X X
c c c c
X X X X X X X X X X X

X = madre de cacao seeds planted 1.25 by 1.25 meters as temporary shade; c = coffee trees (Robusta); P = madre de cacao trees to be left as permanent shade: the distances of the coffee and the madre de cacao trees being 3.75 by 3.75 meters.

Temporary shade is often necessary in order to protect the young coffee plants. In many coffee plantations either castor oil beans (*Ricinus communis* Linn.), papaya (*Carica papaya* Linn.), cassava (*Manihot utilissima* Phol), banana or pigeon pea (*Cajanus cajan* (Linn.) Millsp.) is planted alternately with the coffee trees. The last named of these temporary shade plants enriches the soil. It adds large quantities of leaves rich in nitrogen and its roots penetrate well into the soil, thus improving it. The temporary shade must be gradually thinned out or cut down as soon as the coffee trees are well established and finally only the permanent shade trees should remain. Another important consideration in connection with *Cajanus* is that it yields a valuable food crop while in use as temporary shade.

WEEDING

The coffee plantation should be kept weeded clean. Before the weeds have time to take root, weeding should be done once a month or oftener if necessary. It is cheaper and more profitable to keep the plantation clean from the beginning. Experienced planters recommend hand weeding on light soils and sloping locations. The cut weeds are either buried or left on the plantation. Hand weeding is beneficial on heavy and compact clay soils, level plantations, and in a damp, cool climate. The best time for this operation is during the dry weather. Hoeing must be done at regular intervals whether weeds are present or not. Care must be taken in hoeing not to injure the fine roots of the coffee trees and to cover them well. Heaping the soil around the trees is not good; it encourages more surface roots. Hoeing should be done from the middle of the row toward the trees. It is not advisable to dig too close to coffee trees. The laborers should be instructed not to wound the lower part of the stem of the coffee trees, as wounds encourage the growth of unnecessary sprouts which should be taken off as soon as noticed. Weeds should never be allowed to run to seed.

Cultivation. During the first year, the spaces between the rows of the coffee trees may be cultivated with animal cultivators. This cultivation must be followed by hand hoeing. In places where the use of the animal cultivator is impracticable, hand weeding should be resorted to. All cut weeds should be left in the field to serve as mulch and green-crop manure. As soon as the coffee and shade trees begin to shade the land, cultivation becomes less expensive. The most satisfactory method of controlling the weeds in a coffee plantation is by planting some kind of cover crop that will last for more than six months.

The most advantageous time to cultivate coffee estates is at the beginning of the dry season. Mulching the coffee trees through the dry season with vegetable waste of all kinds is very practical. Even cut cogon or rice straw is good if other materials are not available. This mulch not only enriches the soil around the coffee trees but it prevents rapid evaporation. It should be remembered, however, that an excess of water is harmful, especially during the fruiting season. Irrigation on coffee estates is not practiced for it has been found that irrigated coffees have poor aroma and quality.

PRUNING

In order to concentrate the energy of the coffee trees on the production of fruit, to keep them in good shape, and to facilitate the picking of the berries, coffee trees must be pruned properly. Unpruned trees grow too high and bear comparatively small crops.

To prune well requires careful study and experience. The first pruning is to top the trees as soon as they attain the height of 1.5 to 2 meters, according to local conditions and desire of the farmer. Topping is done by pinching off between the finger and thumb the top soft wood of the bush to a height that will permit the berries to be picked without climbing on the coffee trees. As a result of topping, a number of vertical suckers from under the primary branches and along the stem will appear. These should be carefully removed while young, by cutting them off with a sharp knife but without injuring the bark of the tree. Later on, secondary branches will spring up from the primary branches. Remove all the secondary branches appearing within 15 centimeters of the main stem so as to let in air and sunlight freely. Use a very sharp pocket knife for this purpose. All water sprouts and dead branches should be carefully removed. In case a number of branches grow in different directions from each node of the primary branches, remove every alternate secondary branch. Topping and pruning must be done during the first and second years. All young shoots arising from injuries to the trees near the ground should be cut off early. All epiphytic plants on the coffee trees should be removed. If practicable, pruning should be done twice before cropping. It should commence after harvesting the berries and be finished before the blossoms come out.

Neglected trees can be gradually improved by sawing off all worthless branches and opening up the center of the tree in the first year. Cutting should be done close to the main stalk. Then thin out one-half of the remaining wood in the second year. New shoots soon come out. These must be cultivated to form a new tree. The coffee trees should not be allowed to have more than two or three main stems. All additional suckers at the base of the tree should be removed promptly as they appear.

Small neglected plantings in the College of Agriculture were renovated by cutting off the main stems of the trees about 30 centimeters above the ground, and allowing two to three suckers to form a new tree. Many new sprouts appeared from the stump, but all except the required number were removed as they attained the height of 30 centimeters. On very badly neglected plantings, the trees were cut off near the ground and the whole field plowed. The plowing was done close to each side of the stumps and new shoots appeared in a short time. Very old plants were replanted with new seedlings from the nursery.

CATCH CROPS

Many coffee planters do not approve of the planting of catch crops with the coffee trees while young. In the coffee plantations at the College of Agriculture catch cropping was found beneficial to the College as well as to the coffee trees. The unoccupied land was made to yield some returns for the College. The coffee trees were benefited by the tillage required by the catch crops and the shade afforded by them was found beneficial to the young coffee plants. Tobacco (*Nicotiana tabacum* Linn.), sweet potatoes (*Ipomoea batatas* Linn. Poir.), and corn were found to yield good returns as catch crops, but they do not afford shade to the coffee plants and were found to be rather exhausting to the soil.

A very desirable catch crop for coffee should give good returns to the farmer, not be too heavy for the soil, bear early, and leave the plantation clean when taken from it. It must not be a climbing vine. The farmer can plant either corn, rice, sweet potatoes, tobacco or peanut (*Arachis hypogaea* Linn.) or legumes as catch crops. The kind of catch crop to be planted depends upon the local market requirements and the desire of the farmer. The planting of catch crops may be done while the coffee trees are young, and must be discontinued as soon as the shade and coffee trees begin to entirely occupy the ground.

HARVESTING

Harvesting of the berries of Robusta and Arabica types is done from November to April, while the crops of the Liberian type come in February, March, and April. Arabian coffee must be gathered when the berries become red. Picking must not be delayed for the berries do not hang on well on the branches. Liberian berries do not fall but remain on the trees.

The crop does not ripen at the same time. Two or three pickings are necessary. Whenever practicable, the berries of Arabica and Liberian types should be picked as they become ripe. Care must be taken to pick the berries one by one and never strip off the whole cluster. Undeveloped blossoms should not be injured. When some unripe berries are gathered, they spoil the quality of the coffee. The ground under the trees should be kept clean when gathering the berries. Spreading an old mat under the tree and then shaking it so that the berries will drop on the mat is not a good practice for both unripe and ripe berries will drop. When the trees are high the pickers can bend the branches if careful not to break them. In some places, the farmers allow the berries to remain on the tree until they are dried and then gather them at their leisure. This practice cannot be recommended. If the berries are allowed to get over-ripe on the trees, they are likely to burst and drop when it rains. This will result in the loss of the crop.

METHODS OF PREPARING THE BERRIES FOR MARKET

There are two methods of preparing the berries of coffee for market. The first method is to spread the freshly picked berries in a thin layer on an open dry cement floor or on a wooden floor or in *bilaos*. During the drying process, to secure even and thorough drying, the berries should be stirred with wooden rakes or with the hands several times a day. The berries are raked into heaps and then covered with mats or other similar material in the evening or in case of rain. The berries must be kept spread out during the day and not allowed to heat. The sun-drying process lasts about fifteen days for Robusta and forty days for Liberica in clear warm weather. Incomplete sun-drying will result in making the hulling of the berries difficult. The beans are subject to attack by molds when not properly dried. After complete drying, the dried husk, pulp, slime, hull, and part of the silver skin can be removed by pounding the berries with a pestle in a native mortar. Some farmers use a hand rice-hulling machine for this process.

The second method can be employed where there is a large harvest and a good supply of water. It requires rather a large investment in machinery and equipment. The freshly picked berries are first wet and classified by dropping them into a tank filled with water. All the heavier berries remain at the bottom of the tank and the lighter ones float; these should be discarded. All the berries that remain at the bottom of the tank are ready for pulping. Soaking the berries for a few hours is essential, as the pulp must be soft before it can be removed by the pulper. After soaking, the berries are run through a "disc-pulper" machine which separates the beans from the pulp. Pulping the berries must be done soon after they are washed. The ripe berries pulp more easily if it is done immediately after they are picked. The ordinary machines sold by John Gordon of London are good. Some farmers in Lipa, Batangas, have devised home-made wooden pulpers.

The pulped berries which come from the pulper are covered with a sticky mucilaginous substance, so they are put into a fermenting tank filled with water and washed very thoroughly. The water is changed as often as necessary. After washing, the berries are fermented in a vat filled with water until the sugary substances come off easily. The mass should be stirred from time to time. All light pulp which floats on the water should be removed. Care must be taken not to over-ferment the berries, as this will spoil the quality of the coffee. When the berries are cleaned of the mucilaginous matter they are ready for final washing. The pulped berries can also be fermented in heaps for twelve to sixteen hours without water, by placing them in a perforated tank and turning them over occasionally. After this process the berries are carefully washed. See that all the berries are free from mucilaginous substance. All light berries and other matter which floats during washing should be thrown out. After the washing process the berries are drained thoroughly by placing them in draining boxes or sieves. They are then spread in a thin layer on a drying floor or on an ordinary mat to be sun-dried. Sun-drying must be done immediately after washing. It must be uniform and not too rapid. The berries must be turned over occasionally on the drying floor. The beans are taken in each day in the mat and allowed to continue to dry under cover. Under ordinary conditions, four days sun-drying is sufficient. The beans must never be heated artificially in drying. When the parchment is quite brittle, the coffee can be stored. Coffee in this condition can be kept without harm in a *bodega* (warehouse). The beans can be run through a polishing machine. The broken parchment and dust from the coffee bean can be separated by means of a rice winnowing mill or by using *bilaos* (large shallow bamboo baskets).

COFFEE DISEASES AND PESTS

In the Philippines some of the chief enemies of coffee trees are the fungi, parasitic plants, stem borers, *cercospora*, white bark mold, birds, monkeys, white ants, and cattle. The fungi and insects give the most trouble in the College of Agriculture cultures and in most private plantations.

The most destructive disease is the coffee blight, or rust which is caused by *Hemilea vastatrix* B. et Br. This was the disease that wiped out the coffee industry in Lipa, Batangas. This disease is characterized by the presence of yellow powdery spots containing spores found on either the lower or upper side of the leaves. It causes the leaves to fall. It is most severe during the rainy season. The rust can be controlled by spraying with standard Bordeaux mixture, which costs about twenty centavos a tree for a year's spraying. Standard Bordeaux mixture is prepared as follows: Dissolve 1.8 kilograms of copper sulfate in 95 liters of hot water. Slake 1.8 kilograms of stone lime in water and dilute it to exactly 95 liters. Then mix the two solutions very thoroughly. Spraying must be done before the

coffee trees show any signs of infection. New plantations in the Philippines should be planted only with resistant varieties of Excelsa, Liberica, or Robusta.

Among the insect pests, the coffee borers are the most serious. These bore holes in the wood and thus enter the trunk and branches of the trees. They lay their eggs and the larvae sap the life of the coffee trees. As a result of this, the affected trees wilt and finally die.

Scale insects excrete honey-dew and cause black mold to develop on the leaves.

Beetles, crickets, and caterpillars attack coffee leaves.

Monkeys and cattle damage the coffee trees. The cattle eat the tender leaves of the coffee and the monkeys devour the ripe berries. These animals can be scared off or driven away from the plantation by keeping two or three good watch dogs around the place.

A semi-parasitic plant called dapo kahoi (*Loranthus philippensis* Cham. and Schlecht.) is likely to grow on the stems and branches of the coffee trees. This plant attaches itself to its host by suckers or haustoria which are modified adventitious roots. It should be removed at once.

The great factors in preventing the spread and destructiveness of coffee diseases and pests are clean and proper culture, sanitation, pruning, and spraying. Successful control of diseases and pests depends upon very close attention to detail and upon constant care. Neglect commonly means failure in coffee production. Care, thoroughness, and neatness bring their just reward to farmers in modern plantation work in controlling disease and pests of coffee trees most effectively, as has been abundantly shown by progress secured in the College of Agriculture, through a long series of actual field experiments.

ESTIMATE OF OPENING ONE HECTARE PLANTATION

The following estimate by Mr. Agapito Templo, a practical farmer in Mataas-na-cahoy, Lipa, Batangas, on the cost of opening one hectare of land with coffee may be of use to beginners in coffee growing. In this estimate the land is owned by the planter: it may be either forest or open.

If the land is forest, cut down only the large trees. In case the land is open, plant madre de cacao seeds in order to loosen the soil and at the same time to provide temporary shade for the coffee seedlings.

The following are the expenses involved:

First Year

1.	Madre de cacao seeds at 6 seeds to the hill	₱ 4.00
2.	Planting madre de cacao seeds, 1 by 1.5 meters	5.00
3.	Clearing, lining, and staking	15.00
4.	Holing (1,110 holes)	5.00
5.	Planting coffee seedlings	5.00
6.	Weeding after three months	10.00
7.	Tools (hoes, rakes, trowels)	12.00
8.	House	20.00
9.	Nursery work	20.00
	Total	₱96.00

Second Year

1.	Weeding, twice a year	₱20.00
2.	Replanting	5.00
3.	Topping and suckering of coffee trees, and thinning out the madre de cacao shade	15.00
	Total	₱40.00

Third Year

1.	Weeding, twice a year	₱20.00
2.	Replanting and removing suckers	5.00
3.	Trimming of shade trees	15.00
	Total	₱40.00

Fourth Year

1.	Weeding twice a year	₱20.00
2.	Topping and pruning	5.00
3.	Pruning shade trees	5.00
4.	Ladder and bench	10.00
5.	Drying floor (cement)	100.00
6.	Pulper and storehouse	50.00
	Total	₱190.00

Fifth Year

1.	Weeding, twice a year	₱20.00
2.	Pruning coffee trees	5.00
3.	Pruning shade trees	5.00
4.	Repair of tools and house	10.00
	Total	₱40.00

Sixth Year

1.	Weeding, twice a year	₱20.00
2.	Pruning coffee trees	5.00
3.	Pruning shade trees	5.00
4.	Repair of tools, and house	10.00
	Total	₱ 40.00

Seventh Year

1.	Weeding, twice a year	₱ 20.00
2.	Pruning and suckering coffee trees	5.00
3.	Repair of tools and house	5.00
4.	Pruning shade trees	2.00
	Total	₱32.00

SUMMARY

	Expenses	*Estimated harvest from one hectare*
First year	₱ 96.00	None
Second year	40.00	None
Third year	40.00	₱ 40.00
Fourth year	190.00	100.00
Fifth year	40.00	150.00
Sixth year	40.00	200.00
Seventh year	32.00	350.00
Total	₱478.00	₱840.00

NOTES:

"One hectare plantation will not keep a tenant busy throughout the year so that he must be employed in other work. His main work is to inspect the plantation once in a while, his wages therefore is not included in the above items. Usually, when harvest time comes, he gets ten per cent of the total produce.

"The length of time required before the crop comes to bearing depends upon the soil condition, and the variety of coffee planted. Robusta produced fruits after three years, Excelsa and Liberica after four years. The objection to Robusta is that it is very sensitive to heat especially if the flowering season coincides with the dry season; if the land gets dry during the flowering season practically fifty per cent of the crop is lost. Liberica and Excelsa on the other hand can resist drought lasting several months.

"Bending the branches outward while the trees are young encourages the production of more branches from the main stem. Liberica and Excelsa may be pruned, but if the branches are spread outward it is hardly necessary.

"In some cases one-fifth of the produce when harvested goes to the harvesters or pickers. Sometimes the pickers are paid five centavos for every kilogram of Robusta and Excelsa gathered and two centavos for every kilogram of Liberica.

"A pulping machine is indispensable for the preparation of the Liberica berries, because it will take about forty days to dry the berries under the sun. It takes about fifteen days to dry Robusta berries under the sun.

"For polishing the beans, the rice mill (Paris Engelbert) is ideal. The ordinary native mill is also good. Silverskin adhering to the beans should be thoroughly removed for it gives a very undesirable taste to the coffee. This is especially true with the Liberian type."

STUDIES ON THE CORRELATION BETWEEN THE SEED AND STRAW PRODUCTION OF SOME FIELD LEGUMES [1]

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The study of correlation of characters in crops is a matter of common interest to the farmer and the plant breeder. It is an interesting study, especially with annual farm crops, and is generally fruitful of practical results for the amelioration of these crops.

The cowpea (*Vigna sinensis*), mungo (*Phaseolus aureus*), soybean (*Glycine max*), peanut (*Arachis hypogaea*), and *Phaseolus calcaratus* are the subject of the present study on correlation. These are crops of which both the seed and straw are highly valued, the seed as a source of nutritive food for man and the straw as a palatable feed for live stock. With the exception of peanut, all these legumes are good cover and green manure crops.

In a crop where the seed and the straw are highly valued, the aim of the farmer is to grow a variety or strain that produces plenty of seed and at the same time has heavy tonnage of straw. As it can be grown for dual purposes, such a variety or strain would certainly be much more economical to handle than when grown for only one purpose. Any study therefore on the relationship between the seed and straw producing power of some of the important Philippine legumes should prove valuable to both the farmer and the plant breeder.

So far as the writer knows, the cowpea, mungo, soybean, and peanut have not been chosen as subject for detailed study on correlation. For while Spillman (1913) found correlations between the production of certain seedcoat colors and the occurrence of an anthocyan in the flowers, these characters, as a whole, are of no immediate practical importance to the farmer. Williams and Park (1917), working on more important characters report that in soybean the highest seed yielders had a comparatively low proportion of straw to seed.

MATERIAL AND METHODS

The data presented in this paper were obtained from the 1926–1927 and the 1927–1928 dry season legume cultures of the Division of Farm Crops of the Agronomy Department. All the plants used in this study were obtained from variety test cultures. The data relate exclusively to the

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yield measurements of the seed or pod and straw of seven varieties of cowpea, two varieties of soybean, four varieties of mungo, including one variety of *Phaseolus calcaratus*, and seven varieties of peanut.

The varieties of cowpea used in this study are: Batac Red, Batao White, Conch, Groit, New Era, Progressive, and Victor. The first two varieties are quite widely grown in some towns of Ilocos Norte and have been introduced in the College quite lately. The last five varieties are of United States origin with New Era as the present standard variety in the College: the other varieties are of recent introduction.

Ami is the standard variety of soybean in the College; it is supposed to have been collected in 1912 by Mr. Ami, a student. Otootan is of recent introduction from the United States.

All the varieties of mungo used in this study are supposed to be native varieties. Batac Green and *Phaseolus calcaratus* were introduced in the College from Batac, Ilocos Norte. Dull Green (D. N. 568), and Shiny Green (D.N. 570) are strains isolated from a native variety of mungo.

The varieties of peanut studied all belong to the bushy type. Lemery, Spanish, C. N. 3077, and Valencia were introduced from the Bureau of Agriculture; Kinorales, from Bataan; Tarlac, a small podded variety, from Tarlac Province; and Zambales Lupog, from Zambales Province. All these varieties with the exception of Tarlac have been grown in the College for a number of years.

In obtaining the data, about 100 plants at maturity were picked at random from each variety. The individual plants, except in the case of the different varieties of peanut where the plants were carefully dug up, were cut off close to the ground, put in paper bags with proper label and then brought to the laboratory to dry. The air-dry weights of the seed or pod and of the straw of the individual plants were taken as criteria.

No attempt was made in this study to obtain data from rainy season culture. It is planned to do this in later studies.

In this correlation work, the weight of the straw per plant was used as *subject* and the corresponding yield of seed or pod as *relative*.

EXPERIMENTS AND RESULTS

This paper presents correlation data between the seed or pod and straw production of twenty varieties of field legumes. The correlation tables are not here presented but are on file in the Division of Farm Crops in the College of Agriculture.

Table 1 presents the summary of the results of the correlation studies on cowpeas, soybeans, and mungos. Table 2 shows the summary of the correlation studies on different varieties of peanut.

TABLE 1

Showing the coefficients of correlation between seed and straw production of cowpeas, mungo, and soybean

VARIETIES STUDIED	COEFFICIENT OF CORRELATION AND ITS PROBABLE ERROR	SIGNIFICANCE OF CORRELATION
Cowpeas:		
1. Batac Red	0.863 ± 0.017	decided
2. Batac White	0.857 ± 0.018	decided
3. Conch	0.856 ± 0.023	decided
4. Groit	0.834 ± 0.021	decided
5. New Era	0.812 ± 0.023	decided
6. Progressive	0.839 ± 0.021	decided
7. Victor	0.721 ± 0.033	decided
Soybeans:		
1. Ami	0.936 ± 0.008	decided
2. Otootan	0.859 ± 0.017	decided
Mungos:		
1. Shiny Green	0.743 ± 0.035	decided
2. Batac Green	0.687 ± 0.036	decided
3. Dull Green	0.396 ± 0.056	marked
4. *Phaseolus calcaratus*	0.926 ± 0.010	decided

TABLE 2

Showing the correlation between the pod and straw production of seven varieties of peanut

VARIETIES STUDIED	COEFFICIENT OF CORRELATION AND ITS PROBABLE ERROR	SIGNIFICANCE OF CORRELATION
1. C. N. 3077	0.495 ± 0.051	marked
2. Kinorales	0.438 ± 0.055	marked
3. Lemery	0.754 ± 0.028	decided
4. Spanish	0.647 ± 0.034	decided
5. Tarlac	0.582 ± 0.045	decided
6. Valencia	0.382 ± 0.058	marked
7. Zambales Lupog	0.707 ± 0.034	decided

DISCUSSION OF RESULTS

In the discussion of the results here presented, the rules given by King for the interpretation of the coefficient of correlation according to its relation to the probable error are taken as a guide.

Referring to tables 1 and 2, and applying King's rules, it may be seen readily that the coefficients of correlation between the seed and straw production of cowpea, soybean, mungo, and peanut studied were decided. The coefficients of correlation between the seed and the straw production of cowpea varied from 0.721 ± 0.033 to 0.863 ± 0.17; of soybean from 0.859 ± 0.017 to $0.936 + 0.008$; and of mungo from 0.396 ± 0.056 to 0.926 ± 0.010. The coefficients of correlation of the different varieties of cowpea were 0.863 ± 0.017 for Batac Red; 0.857 ± 0.018 for Batac white; 0.839 ± 0.021 for

Progressive; 0.812 ± 0.023 for New Era; 721 ± 0.033 for Victor; 0.834 ± 0.021 for Groit; and 0.856 ± 0.025 for Conch. Of the soybeans, variety Ami had a correlation of 0.936 ± 0.008 while variety Otootan had 0.859 ± 0.017. Among the mungo varieties the coefficients of correlation were: Shiny Green, 0.743 ± 0.035; Batac Green, 0.687 ± 0.036; Dull Green, 0.396 ± 0.056; and *Phaseolus calcaratus*, 0.926 ± 0.010.

In the case of the seven varieties of peanut studied, the coefficients of correlation between the pod and straw production varied from 0.382 ± 0.058 to 0.754 ± 0.028. Lemery had the highest coefficient of correlation and Valencia had the lowest. The coefficients of correlation of the different varieties were: C. N. 3077, 0.495 ± 0.051; Kinorales, 0.438 ± 0.055; Lemery, 0.754 ± 0.028; Spanish, 0.647 ± 0.034; Tarlac, 0.582 ± 0.045; Valencia, 0.382 ± 0.058; and Zambales Lupog, 0.707 ± 0.034. The coefficients of correlation of C. N. 3077, Kinorales, and Valencia were below the 0.5 mark, but the existence of correlation, according to King's rules, was still a practical certainty.

That the degree of association between the seed and straw producing power of the different legumes studied varied considerably is very evident. This variation may be due to the degree of purity of the different varieties studied. While Williams and Park (1917) report that, in the case of soybean, the highest seed yielders had a comparatively low proportion of straw to seed, the data on the two varieties of soybean, at least, indicate that in the different strains within the varieties, the seed and straw yield characters have a decided correlation.

The data presented in this paper show the possibility of isolating varieties or strains of cowpea, soybean, mungo, and peanut that are both heavy yielders of seed and of straw. The knowledge that there exists a marked if not decided correlation between the seed yield character and the straw yield character of the crops mentioned above would aid greatly in their amelioration.

SUMMARY OF CONCLUSIONS

The data reported in this paper seem to justify the following conclusions:

1. Of the twenty varieties of field legumes studied, there existed a positive correlation between the seed and straw production.

2. Among the seven varieties of cowpea and two varieties of soybean, the correlation between the seed and straw production was very decided. The correlation values varied from 0.721 ± 0.033 to 0.863 ± 0.017 in the case of cowpea, and from 0.859 ± 0.017 to 0.936 ± 0.008 in the case of soybean.

3. Of the four varieties of mungo, one showed marked correlation and three gave decided correlation.

4. Of the seven varieties of peanut, four showed decided association between the pod and straw production while three varieties exhibited marked correlation only.

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REPORT ON RECUPERATIVE GROWTHS WITHIN A YEAR OF SOME PLANTS INJURED BY A TYPHOON[1]

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WITH FIVE TEXT FIGURES

This report is primarily botanical in nature, but because of the economic value of the plants included, the information it conveys is of practical importance. There is also interest and value in knowing how rapidly plants may recover from serious injuries caused by a severe typhoon. The observations were made soon after the typhoon that occurred during the

Fig. 1a.—Mango trees, soon after the typhoon.

night of November 5 and 6, 1926, and one year later. This typhoon was one "of unusual intensity". "The College of Agriculture was within the path of the high wind and the destruction on the College grounds was very considerable".

OBSERVATIONS MADE

Mango trees. Four mango trees were blown to the ground. These trees are of different varieties. The first one (see fig. 1a) was *Mangifera*

[1] Experiment Station contribution No. 534. Received for publication on February 8, 1928.

indica var. Carabao. This tree, although it had begun to recover from the damage stands no longer on the spot as construction of a building made it necessary to move it. The second tree in the row is *M. indica* var. Tjenkir, imported from India and was planted on October 6, 1913, so was about 13 years old when the typhoon blew it to the ground. The third mango tree in the row is variety Alfonse, introduced into the College on October 6, 1918, and was 8 years old at the time of the storm. The fourth tree is variety Carabao, planted on July 15, 1916, so was about 10 years old at the time of the storm.

Fig. 1b.—The mango trees shown in fig. 1a, one year later.

Within a few days after the typhoon, laborers in the College cut off all the small branches of these trees so that practically not a leaf was left on them. Then, by means of a device which is described in this report, (see fig. 4), one by one, these trees were raised and propped by wooden poles, (fig. 1a). Some of the large as well as the small roots on the side on which the trees fell were cut off, to facilitate the raising. One week later, new leaves and branches began to appear; one year later, the trees had so recovered that they were able to stand erect without the props. No doubt the damage caused a material setback in the growth of the trees, but they are saved. The loss is far less than if the orchard had been replanted.

Aninapla (*Tag*); *lañgil* (*Tag*)[2], *Albizzia lebbek* (*Linn.*) *Benth.* This tree was blown flat on the ground. It looked after the storm as though it was

[2] Name given in Merrill, E. D. 1923. An enumeration of Philippine flowering plants. 530 p. Manila: Bureau of Printing.

a complete loss. A force of six laborers raised it up, using the device (see fig. 4). The beautiful top of the tree was cut off leaving only the main trunk. This *Albizzia*, planted about 10 years ago, is a rare tree on the Campus, so no effort was spared to save it. About one-fourth of the root system was damaged, part as a result of the fall of the tree and part was cut off by the laborers in digging a trench by the side of the tree to facilitate the the lifting. Once restored to normal position, the tree was left without props, (fig. 2a).

A week later, dormant buds were awakening and new leaves and branches began to appear. It is regretted that the subsequent developmental changes were not noted. That the tree is fast recovering may be seen in figure 2b, this recovery plainly shows that valuable trees blown down by typhoons may be saved.

Fig. 2a.—*Albizzia lebbek*, soon after the typhoon.

Fig. 2b.—The *Albizzia* tree (fig. 2a) one year later.

West Africa oil palm. As with other palms, this plant (fig. 3a) was scarcely damaged by the typhoon. Only a little disorder in the leaves was noticed and even long before the end of the year, the tree was back to its normal state.

Banana plants. Being herbaceous or fleshy, banana plants were severely damaged by the typhoon; the leaves were shredded to tatters, trunk broken and in the case of the large varieties, particularly the Saba, the full grown plants were uprooted. In such cases the plant is a complete loss; for although the plants were raised to normal position, the bunches

Fig. 3a.—African oil palm and several species of trees, soon after the typhoon.

Fig. 3b.—The same plants shown in fig. 3a, one year later.

of fruit produced were so small that they hardly paid for the expense of restoring them. However, the rhizome, or underground stem produced suckers that took the place of those that were blown down. This report is based not only on the few plants shown in figure 3a, but also on small banana plantings in yards in the vicinity of the College. The banana plants recovered rapidly and in three to five months time, the plantings were almost back to the normal condition and, in less than one year, banana fruits in local stores and markets were as abundant as before the storm.

THE LIFTING DEVICE USED

The lifting device that was used to raise the large trees was efficient. Other devices are known and used with mathematical precision, but this one was the product of the ingenuity of six unskilled laborers employed on the Campus. Because of its efficiency and simplicity it is here described.

The device (see fig. 4) consisted of a 2-inch rope, 20 meters in length; two strong bamboo poles, a wooden post, two or three wooden props and wooden pegs. It required six men to operate it properly on large trees; but fewer men may be sufficient if the tree to be lifted is smaller.

The tree (see fig. 4) was lying flat on the ground. A small trench was dug at point *H*, to cut out all damaged roots at that point. One end of the rope *B* was tied around the upper end of the trunk of the tree and the other to a wooden pole *A*, and coiled around the wooden post *C*, one end of which was driven one meter deep in the ground in an inclined position; the post served in a way similar to a capstan on a boat and was held firmly to the ground by the pegs *D*. To help lift the tree, the two bamboo stems *E* were employed as a rider as shown in the illustration.

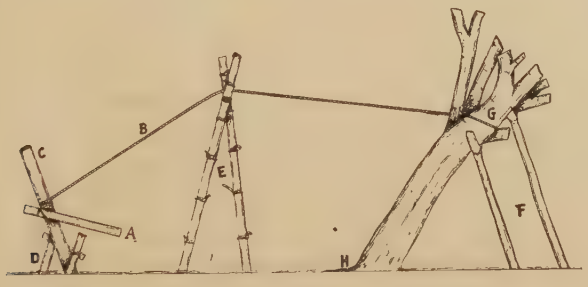

Fig. 4.—The device used in lifting trees to normal position.

Three men rotated post *C*; one man attended to the arrangement of the position of the bamboo posts *E* and another man stationed at *F*, watched that these wooden props were always in such position as to prevent the trunk from falling again to the ground. The post *C* was rotated slowly until the trunk was standing erect or almost so. One man directed the work. It took four hours for six men to raise the trunk of the tree shown in figure 2a.

A COMPARATIVE STUDY OF THE EFFECT OF COPRA MEAL AND DRIED SHRIMPS AS SUPPLEMENTS IN RATIONS FOR LAYING HENS[1]

JOSÉ A. SERRANO

WITH ONE CHART

How to increase the egg production of laying hens is one of the principal problems of every poultry raiser. One of the factors that may be considered of importance in attaining this end is the nature of the feeds given. Studies along this line are essential so that the relative effects of various supplemental feeds which are available in the Islands may be determined. Knowledge of this nature should lead to the foundation of a laying ration that will be good an d practicable and give the best and most economical results to local poultry raisers.

A number of studies have been carried on the nutritive value of copra meal. Santos (1920) found that copra meal is fairly rich in proteins for it contains over twenty per cent crude protein. However, Derecho (1921) found that guinea pigs fed exclusively with copra meal could not live more than three weeks. Sulit (1926) in his study also with guinea pigs found that thirty-seven per cent copra meal in the feed gave good results. Sulit confirmed the report of Derecho and stated that when copra meal was present in seventy-five to eighty-five per cent, it has a deleterious effect. Crucillo (1926) studying the effects of different amounts of copra meal on laying Native hens found that twenty to thirty per cent copra meal in the ration gave the best results.

Concerning studies on shrimp as feed very little has been done. Many investigators have worked on the effects of animal proteins, such as beef scrap, meat meal, tankage, fresh horse meat, sour milk, fish meal, and others as supplements in rations for laying hens, but so far very little attention has been given to shrimp. Embody (1918) used shrimp in the form of meal fed to fish in combination with different animal and vegetable proteins. He found that a combination of meat meal and shrimp with a small amount of flour is the best and most economical. Santiago (1926) in his work on growing pigs reported that good results were obtained by supplying shrimp as supplement to corn and rice bran in the proportion of from six-tenths to one part shrimp to a mixture of six parts corn and thirteen parts rice bran.

The object of this study was to determine the relative effects of copra meal and dried shrimps as supplements in rations for laying hens. It was

[1] Thesis presented for graduation, 1927, with the degree of Bachelor of Agriculture from the College of Agriculture No. 263; Experiment Station contribution No. 535. Prepared in the Department of Animal Husbandry under the direction of Dr. F. M. Fronda.

conducted in the Department of Animal Husbandry, College of Agriculture at Los Baños. The experiment was started on August 29, 1925, and ended on August 27, 1926, covering a period of fifty-two weeks.

MATERIALS AND METHODS

The flock

Cantonese pullets were used in this study. The pullets were almost of the same age having been hatched in the same season of the year.

The house

Three pens, 2.75×3.65 meters with a pasture 12×30 meters adjoining each, were used. Twenty Cantonese pullets and one cockerel were placed in each pen and designated as lots 1, 2, and 3. Each pen was provided with six trapnests and feeding and bamboo drinking troughs.

Feeds and feeding

The feed consisted of grain and mash fed, as much as possible, fifty-fifty by weight. The ration containing twenty-five per cent copra meal which is considered to be the best proportion (Crucillo, 1926) was compared with dried shrimps. In a basal ration with twenty-five per cent copra meal, the amount of proteins is equal to the same ration containing 7.62 per cent shrimp. The dried shrimps used here were fresh water shrimps belonging to the species *Palaemon lanceifrons* Dana. Some small snails and a small fish known as goby (*Glossobins giurus*) were mixed with these shrimps (Santiago, 1926).

The grain part of the feed for all the lots was the same, and was composed of one part by weight of cracked corn and one part of palay. The basal mash consisted of three parts by weight of rice bran and two parts by weight of corn meal. One per cent of common salt was added to the total mash.

In addition to the basal mash the following were given: five parts by weight of copra meal to lot 1, one and four-tenths parts by weight of shrimp to lot 2, and two and five-tenths parts of copra meal and seven-tenths part of shrimp by weight to lot 3. Lot 3 was used as the check lot.

One-third of the whole amount of the grain was given in the morning and two-thirds in the afternoon. Dry mash was open to the birds at all times, and if found necessary wet mash was given between eleven and twelve o'clock. If the birds ate only a little of the mash the amount of grain was reduced so that they would eat more mash. The birds had access to fresh water at all times.

BREAKING THE BROODINESS OF THE HENS

Each pen was provided with a broody coop. As the birds were not allowed to sit on their eggs, broodiness was broken by confining them in the broody coop for four or five days.

Observations on the hens

The birds were weighed at the beginning of the experiment. Monthly weighings were made thereafter to find whether the birds were gaining or losing in weight. Birds found to show any signs of sickness or birds not in good condition were isolated and treated. In case of sickness from an unknown cause, the bird was sent to the Veterinary hospital for treatment.

Testing the fertility of the eggs

The eggs were artificially hatched in a 250-egg Queen hot water incubator. Three settings were made. The first was put down on December 23, 1925, the second, on January 1, 1926, and the third, on March 27, 1926. In accordance with the recommendation of Leoncio (1924) no eggs that were more than ten days old were used.

Observation of the chicks

Forty-eight hours after hatching, the chicks were weighed before they were put down, and then at four week intervals for twelve weeks. A Queen coal stove brooder with a capacity of 500 chicks was used to supply the heat needed by the chicks during the first week. The brooder was placed in a small rat-proof brooder house, 3.25×3.6 meters in size.

RESULTS

Egg production of the different lots

The individual egg production ranged from zero egg to 147 eggs a year. Two birds, one in lot 1 and one in lot 2, did not lay an egg throughout the period covered by the experiment. No bird in lot 1 produced more than one hundred eggs a year. In lot 2, eight birds produced more than one hundred eggs a year. In lot 3, which is the check lot, four birds laid more than one hundred eggs a year. The highest egg layer was in lot 2.

The monthly percentage of egg production of the different lots is given in table 1. These data are graphically shown in chart 1. The monthly percentage of egg production of the different lots was determined by dividing the actual number of eggs laid by the birds in each lot during the month by the number of possible eggs, which is assumed to be an egg every day by each bird, and multiplying the result by 100.

TABLE 1

Showing the percentage of egg production of each lot each month

MONTHS	LOT 1 (COPRA MEAL)	LOT 2 (DRIED SHRIMPS)	LOT 3 (CHECK)
	per cent	*per cent*	*per cent*
September	15.10	12.80	15.10
October	8.38	19.50	17.80
November	6.50	21.40	13.40
December	15.80	24.30	22.60
January	20.10	29.03	29.99
February	21.03	31.78	28.38
March	11.23	32.59	33.44
April	14.70	30.50	22.60
May	11.29	30.89	22.39
June	16.04	25.00	17.19
July	13.50	25.29	19.86
August	17.34	22.41	21.71

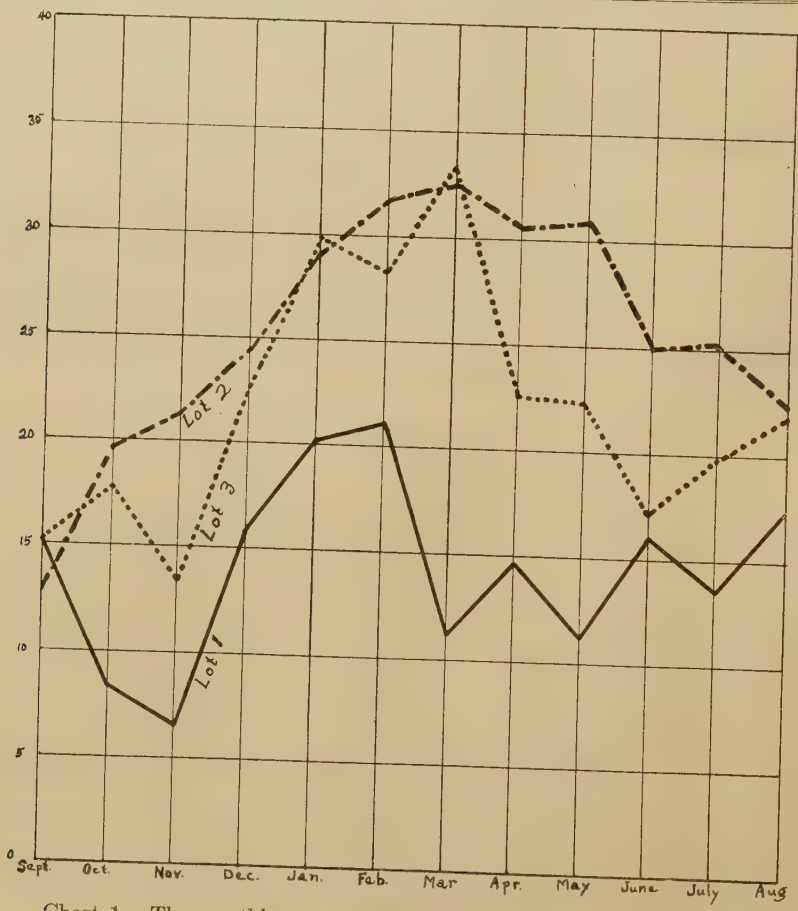

Chart 1.—The monthly percentage of egg production in the three lots.

As may be seen from table 1 the copra meal and the check lots gave a high percentage of egg production during the first month of the experiment, but the shrimp lot was low. During the succeeding month, lot 1 (copra meal) dropped down and lot 2 (shrimp) increased considerably. Throughout the year lot 2 gave the highest percentage of egg production. Lot 3 (check) was always higher in the percentage of egg production than lot 1.

TABLE 2

Egg production per hen and weight of eggs

	LOT 1 (COPRA MEAL)	LOT 2 (DRIED SHRIMPS)	LOT 3 (CHECK)
Total eggs laid	946	1772	1546
Total number of eggs weighed	933	1749	1519
Total weight of eggs in grams	36368.34	67826.22	59180.24
Average weight of egg in grams	38.98	38.78	38.96
Average yearly production per hen	59.51	92.64	81.74

Table 2 shows the egg production per hen and weight of eggs of the different lots. There was no apparent difference in the average weight of eggs. Lot 2 produced an average of 92.64 eggs per hen in the year, lot 3, 81.74 eggs, and lot 1, only 59.51 eggs, the lowest of the three lots.

Feed consumption

Average consumption per hen. From table 3 it may be seen that each of lots 2 and 3 consumed more feed than lot 1. This difference was partly

TABLE 3

Feed consumption of the different lots

	LOT 1 (COPRA MEAL)	LOT 2 (DRIED SHRIMPS)	LOT 3 (CHECK)
	kgm.	*kgm.*	*kgm.*
Total grain consumed	267.80	291.50	290.40
Total mash consumed	206.60	248.60	242.70
Average grain consumed per hen in the year	15.11	15.11	15.24
Average mash consumed per hen in the year	11.32	12.97	12.74
Average feed consumption per hen in the year	26.43	28.08	27.98

due to the fact that in the latter part of the experiment there were only fifteen birds in lot 1, while lots 2 and 3 had nineteen birds each. The average yearly feed consumption of each hen shows no appreciable difference in the grain portion of the feed. There was however a little difference in the mash consumption, perhaps because the ration with shrimp is more palatable than the feed with no shrimp. Lot 1 consumed a less amount

of mash than either lot 2 or 3. On the total feed consumption per hen in the year, lot 2 was the highest and lot 1, the lowest.

Relative cost of feed used and of eggs produced

In the computation of the cost of feed the price used was the average cost of the feed from the time the experiment was begun until it was closed, as supplied by the Department of Animal Husbandry. They are as follows:

Feeds	*Cost per kilogram in centavos*
Corn	0.0876
Palay	0.115
Rice bran	0.059
Copra meal	0.0696
Shrimp	0.229
Salt	0.027

The price of eggs was 72 centavos a dozen.

As shown in table 4, lot 1 consumed ₱32.50 worth of feeds and produced eggs valued at ₱56.76, giving a gain over the cost of feeds of ₱24.26. Lot 2 consumed ₱56.42 worth of feeds and produced eggs valued at ₱106.32, giving a gain over the cost of feeds of ₱49.90. Lot 3 consumed ₱50.61 worth of feeds and produced eggs valued at ₱92.76, giving a gain of ₱42.15 over the cost of feeds. The profits above the cost of feeds per hen were: ₱2.04 in lot 1; ₱2.62 in lot 2; and ₱2.24 in lot 3.

TABLE 4

Relative cost of feed used and of eggs produced in the year

	LOT 1	LOT 2	LOT 3
	pesos	*pesos*	*pesos*
Total value of feeds consumed	32.50	56.42	50.61
Total value of eggs produced	56.76	106.32	92.76
Profit above cost of feeds	24.26	49.90	42.15
Value of eggs produced per hen at six centavos each	3.54	5.56	4.90
Value of feed consumed per hen	1.50	2.93	2.66
Profit above cost of feeds per hen	2.04	2.63	2.24

Observations on the hens

The average weight of hens at the beginning and at the close of the experiment are given in table 5.

TABLE 5

Average weight and growth of hens

	LOT 1	LOT 2	LOT 3
	grams	*grams*	*grams*
Total weight of hens at the beginning of the experiment	20,750.00	21,100.00	21,700.00
Average weight of hens at the beginning of the experiment	1,037.00	1,055.00	1,085.00
Total weight of hens at the close of the experiment	17,900.00	24,750.00	23,000.00
Average weight of hen at the close of the experiment	1,193.00	1,303.00	1,290.00
Average increase in weight per hen	156.00	248.00	125.00

It will be noted that at the beginning, lot 1 had the highest average weight with lot 2 the second highest, and lot 3, the lowest. At the close of the experiment the birds in lot 2 were the heaviest and those in lot 3 the lightest. For the entire period of the experiment lot 2 had an average increase of 248 grams, lot 1, 158 grams, and lot 3, only 125 grams.

Mortality of the hens. Table 6 gives the percentage of mortality of the birds in the different lots. Five birds died in lot 1, one in lot 2, and one in lot 3. Expressed in percentage, the mortality is thirty for lot 1, five for lot 2, and five for lot 3.

TABLE 6

Percentage mortality of hens

	LOT 1	LOT 2	LOT 3
Number of hens at the beginning of the experiment	20	20	20
Number of hens at the close of the experiment	15	19	19
Number of hens that died	5	1	1
Percentage of mortality	30	5	5

Fertility and hatchability of eggs

Table 7 gives a summary of the results of the incubation of the eggs. From this table it may be seen that lot 2 gave the highest percentage of infertile eggs, with lots 1 and 3 nearly equal. This shows that there were more infertile eggs laid in lot 2 than in either of the other two lots. Lot 3 gave the highest percentage of D_1 (germs that died during the first week of incubation); lot 2, the lowest. Lot 1 gave the highest percentage of D_2 (germs that died during the second week of incubation) and lot 3, the lowest. The percentage of D_3 (eggs that failed to hatch) was highest in lot 3 and lowest in lot 2. Lot 2 gave 48.91 per cent hatch which was the highest, lot 1 with 43.14 per cent was second, lot 3 with 36.19 per cent, the lowest.

TABLE 7

Fertility and hatchability of eggs

	LOT 1	LOT 2	LOT 3
Total number of eggs set	102	184	152
Percentage of infertile eggs (from all eggs set)	11.76	14.67	11.84
Percentage D_1 (from all the eggs set)	12.75	11.96	14.47
Percentage D_2 (from all the eggs set)	7.84	7.07	6.58
Percentage D_3 (from all the eggs set)	24.51	17.39	30.92
Percentage (hatch from all the eggs set)	43.14	48.91	36.19

Observations on the chicks

Weight and growth of the chicks. Observations on the chicks were recorded from the time the chicks were hatched to the time they were twelve weeks old. Table 8 gives the summary of the weight and growth of the chicks. There were no appreciable differences in the weight of the forty-eight hour old chicks. In the copra meal lot the chicks showed slightly more vigor than in the other two lots as indicated by their more rapid increase in weight.

TABLE 8

Weight and growth of chicks

AGE OF CHICKS	LOT 1		LOT 2		LOT 3	
	Number of chicks	Average weight	Number of chicks	Average weight	Number of chicks	Average weight
		grams		*grams*		*grams*
Forty-eight hours	44	23.24	90	24.86	55	22.46
Four weeks	37	86.68	79	65.19	51	78.31
Eight weeks	35	172.35	73	156.03	49	169.98
Twelve weeks	34	329.44	69	313.04	48	324.56

Mortality of the chicks. Table 9 gives the percentage of mortality at four weeks intervals and the number of chicks that died during the twelve weeks of observation. It may be noted that in all the lots the mortality of the chicks was high during the first four weeks, but in all cases for the period of observation the mortality may be considered as normal. Enerva (1926) and Dañgilan (1926) found that the critical period in the life of both the Native and Cantonese chicks was during the first four weeks after they were hatched.

TABLE 9

Mortality of chicks

AGE OF CHICKS	LOT 1			LOT 2			LOT 3		
	Number of chicks	Number of deaths	Percentage mortality	Number of chicks	Number of deaths	Percentage mortality	Number of chicks	Number of deaths	Percentage mortality
Forty-eight hours	44	—	—	90	—	—	55	—	—
Four weeks	37	7	15.91	79	11	12.22	51	4	7.27
Eight weeks	35	2	5.41	73	6	7.59	49	2	4.08
Twelve weeks	34	1	2.86	69	4	5.62	48	1	2.04

DISCUSSION OF RESULTS

From the results obtained in this experiment a decided influence of the dried shrimp on egg production was shown. The rations having practically the same amount of proteins would logically give about the same egg production. But the shrimp lot produced many more eggs than the other two lots; and this superiority can be credited only to the nature of the source of protein. It may be noted that at the beginning of the experiment the copra meal lot produced the most eggs, but decreased later. This decrease may be due to the stimulating effect of the toxic substance in the copra meal, an effect observed also by Taleon (1924).

Fronda (1919) using snails realized ₱2.31 over the cost of feeds from the lot fed with animal proteins; while the copra meal lot showed a loss of ₱6.43. Kaupp (1921) concluded as a result of his investigations that it is not wise to keep birds for egg production unless some form of feed containing animal proteins is given.

The results found in this study once more proved the superiority of animal proteins over those from vegetable sources. This superiority may be because vegetable proteins do not carry the amount of mineral elements necessary for growth and egg production, as was claimed by Kennard and White (1922) who obtained satisfactory results with vegetable proteins when supplemented with suitable mineral mixtures.

This experiment showed also that the lot fed with animal proteins gave the highest production and profit. The low production of the shrimp lot in the beginning may be because the birds were not yet accustomed to the new kind of feed. In the fertility of the eggs and the growth of the chicks, the copra meal lot was better than the shrimp and the check lots. The copra meal lot had the lowest percentage of mortality. The same result was also found by Ahrens (1917). Philips, Carr, and Kennard (1918) found that for growing chicks fed the basal ration of ground corn and corn meal as grain and a mash of corn bran, ash, and charcoal, meat scrap was somewhat inferior to soybean meal or to the combination when 10 per cent protein from soybean meal was added. But in the percentage of hatch from all the eggs set, the shrimp lot was higher than the copra meal and the check lots. This high rate was owing to the high percentage of eggs that failed to hatch in the copra meal and the check lots.

SUMMARY AND CONCLUSIONS

1. There was a gain in weight of the hens in the three lots. The highest was in lot 2 (shrimp lot), with lot 1 (copra meal lot) as second, and lot 3 (check lot), the lowest.

2. On the average, the hens from each lot consumed equal amounts of the grain feed given to them. Lot 2 consumed the most mash feed and lot 1, the least. In the total average consumption per hen there was but little difference.

3. Lot 2 produced the highest number of eggs per bird, 92.64, followed by lot 3 with 81.74, and lot 1 with 59.51, the lowest.

4. There was no appreciable difference in the size of the eggs produced in the three lots.

5. Lot 1 gave the highest percentage of fertile eggs. Lot 2 gave a high percentage of infertile eggs, a percentage higher than either of the other two lots.

6. The chicks hatched from lot 1 were more vigorous and grew slightly faster than those in either lots 2 and 3. This would appear to show that copra meal has some influence on the growth of the chicks.

7. A gain of more than two pesos per hen in one year over the cost of the feed was registered in each lot. Lot 2 gained fifty-eight centavos more than lot 1 and thirty-eight centavos more than lot 3.

8. The results gathered here show that dried shrimp is much better than copra meal when used as supplement in rations for laying hens.

9. Although the price of the feed consumed by lot 2 was high, yet the lot yielded more profits than either of the other two lots.

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A COMPARATIVE STUDY OF CORN AND CASSAVA AS FEEDS FOR HOGS: II. GROUND CORN VS. RAW CHOPPED CASSAVA[1]

MARIANO MONDOÑEDO
Of the Department of Animal Husbandry

The feeding trial here presented is a continuation of the report by Mondoñedo and Bayan (1925) on the comparative value of corn and cassava. In the previous work the cassava used was peeled and cooked; in the present work it is used raw and unpeeled. The experiment was conducted in the Department of Animal Husbandry, College of Agriculture, Los Baños, Laguna, beginning May 17, 1927, and covering a period of 70 days.

PIGS USED

The pigs used, consisting of 10 gilts, were eight months old at the beginning of the experiment. They were College bred Berk-Jalas.

RATIONS USED

The rations used were as follows:

	Lot I	*Lot II*
Corn	20 parts	—
Cassava	—	20 parts[2]
Rice bran	70 "	70 "
Copra meal	8 "	8 "
Shrimps	2 "	2 "
Total	100 "	100 "

One per cent of a mineral mixture consisting of equal parts corn-cob-charcoal and common salt was added to each ration.

The prices of the feeds at the time this test was conducted were as follows:

Corn	@ 6.7 centavos a kilogram
Rice bran	@ 5.0 centavos a kilogram
Copra meal	@ 5.0 centavos a kilogram
Cassava	@ 2.0 centavos a kilogram
Shrimps	@ 22.0 centavos a kilogram

[1] Experiment Station contribution No. 536. Received for publication May 7, 1928.

[2] Two parts by weight of unpeeled, raw (chopped) cassava was used in lot II and 1 part corn in lot I as equivalents.

The price of the corn mixture was 6.68 centavos a kilogram; cassava mixture, 5.64 centavos a kilogram.

The varieties of cassava used were the Angular and the Kapo White.

MANAGEMENT

The pigs in both lots occupied together a pen with a small yard adjoining. They had access at all times to a vacant pasture lot where they could exercise and graze. Growth of edible grasses was, however, poor and scant during the test. The animals were separated only at feeding time—at 6:00 a. m. and at 4:00 p. m. They were fed all they could easily clean up. They had access to water in troughs and to shade at all times. The hose was turned on them once or twice a day to keep them cool. Partial weights were taken every ten days.

Table 1 summarizes the results obtained in the test:

TABLE 1

Showing results of tests

	(LOT I)	(LOT II)
	CORN..... 20	CASSAVA..... 20
	RICE BRAN..... 70	RICE BRAN..... 70
	COPRA MEAL..... 8	COPRA MEAL..... 8
	SHRIMPS..... 2	SHRIMPS..... 2
Number of pigs	5	5
Duration of test	70 days	70 days
Average age of pigs	8 months	8 months
Average initial weight of pigs	33.06 kgm.	32.64 kgm.
Average final weight of pigs	58.52 "	60.36 "
Average gain per pig	25.46 "	27.72 "
Average daily gain per pig	0.364 "	0.396 "
Feeds consumed per pig	110.00 "	132.00 "
Feeds consumed per kilogram gain	4.32 "	4.76 "
Feeds cost per kilogram gain	₱ 0.28	₱ 0.26

The results showed that: (1) the cassava lot made faster and greater gains than the corn lot; (2) the consumption of the cassava lot was 9 per cent greater than that of the corn lot; (3) the cost per 1 kgm. gain was 2 centavos less in the cassava lot, a saving of 11 per cent from the cost of feed to make the gains; and (4) from the standpoint of slaughter for pork the corn lot turned out to be the better finished hogs, but from the breeder's standpoint the cassava lot gave more active and growthy pigs.

It is interesting to note that while cassava in the proportion used contained 26 per cent less dry matter than corn, better results were obtained from the use of cassava than from corn. The beneficial effect of roots, such as sweet potatoes, turnips, carrots, etc., upon live stock when fed in conjunction with other concentrates is of common knowledge among stockmen. It is evident that cassava, like other roots, contains something, at present unknown, which gives it a feed value higher than what might be normally

expected from its dry matter content. Or it is possible that cassava (and other roots) induce better utilization of the other ingredients of the ration.

The pigs on cassava did not show any evidence of poisoning resulting from feeding the cassava raw and unpeeled.

In our previous work it was found that on the basis of three parts of peeled cooked cassava, which is equivalent to two parts of raw cassava, flint yellow corn and cassava had approximately the same feeding value. In using the same proportion in the present work, that is, 1 part corn for 2 parts of raw cassava it was found that cassava and corn produced about the same results in the amount and rate of gains, corroborating our previous results. The advantage of using cassava instead of corn is in the cost of gain which is slightly in favor of cassava and its suitability for feeding breeding pigs where growth is to be desired rather than fattening.

A direct comparison of raw cassava and cooked cassava will be the object of our next study.

SUMMARY

1. Raw chopped cassava with other feeds as used in this experiment gave a faster, greater, and more economical gain than ground corn.

2. Cassava alone or in combination with the feeds used in this experiment is just as palatable and appetizing as ground corn.

3. Throughout the feeding period there was no evidence of poisoning effect of cassava on the pigs fed. The Kapo White and Angular varieties of cassava, the ones used in this experiment, therefore, can be fed raw and unpeeled.

4. Judging from results obtained in the two studies reported (I and II) the use of cassava may be recommended for growing breeding pigs in dry lot or on poor pasture.

THE BAKER MEMORIAL FUND

Dean Charles Fuller Baker was ever opposed to ostentation. He was a firm believer in the principle or doctrine that the care of the human being should take precedence over ornate works of art in a community.

The movement of the College of Agriculture to express gratitude for the Dean's devotion to the institution and his great services in its development and the development of the Philippines and his incalculable contribution to Malayan Entomology by a permanent fund to provide aid for self-supporting senior students in the College is carrying out this belief and practice of Dean Baker.

The following announcement and appeal was sent by the Baker Memorial Committee to all the newspapers in the Philippines. By letters and other means, the committee is supplementing this appeal. It is hoped that every one who knew of Our Dean's long years of unselfish labor will help make this fund a worthy memorial to "an extraordinary man," a "man who ran a great race," "a great scientist," "a great teacher," a "maker of men."

BAKER MEMORIAL
AT THE
COLLEGE OF AGRICULTURE

The late Dean Charles Fuller Baker believed strongly in the youth of the Philippines; he never failed to come forward in their defense and in their aid. While Dean of the College of Agriculture he did all he could to develop the best type of manhood in the students. The Dean used to say that when he saluted the boys, he was saluting the leaders ten or fifteen years hence.

The Dean was particularly interested in the Self-Supporting Students who came from all parts of the Islands, determined to secure an education. He helped these students in every way possible, oftentimes, financially.

To perpetuate this kind thought of the Dean for the Self-Supporting Students, the Faculty of the College of Agriculture unanimously voted to raise a trust fund to be deposited in perpetuity in some safe investment the interest to be used to help deserving seniors working their way in the College of Agriculture.

We appeal to the members of the faculty, past and present, to the alumni, and to all students who have ever registered in the College of Agriculture, to all friends of Dean Baker, and to those who have at heart the cause of self-supporting students with which the late Dean so identified himself to help us in this campaign that the memory of him who so nobly served may be perpetuated.

Send contributions to Secretary-Treasurer of the Committee. A receipt for remittance will be mailed to contributor.

THE COMMITTEE,

(Signed) Emma S. Yule, *Chairman*
Vicente C. Aldaba, *Member*
Inocencio Elayda, *Member*
Manuel L. Roxas, *Member*
L. B. Uichanco, *Member*
Toribio Vibar, *Secretary-Treasurer*

EXTENSION DIVISION NOTES

Prepared by Moises M. Kalaw under the supervision of Professor I. Elayda

The Occidental Negros Carnival

In the last issue, under this column, mention was made of the Occidental Negros Carnival. Professors Roxas and Uichanco of this College were invited as guests of the Carnival authorities to give lectures on some phases of the Philippine sugar industry. They were very much impressed with this instructive provincial carnival. They said that in magnificence it is comparable to the annual national carnival held in Manila. It was a complete success in every respect, very enjoyable and highly instructional. Two booths in the carnival presented miniature sugar centrals complete in all parts of a central and in actual operation. The sugar cane industry was presented in a way far beyond any exhibit given in the past in the Islands. It has been commented that if all provincial carnivals would be as instructive as this one in Negros they are well worth the money and effort spent on them.

Abaca Investigation

At about this time last year Professors Aldaba and Elayda made a tour of Leyte investigating the abaca industry. On their return they submitted a report bringing out facts about the abaca industry which had not been reported before. Besides the discussion of local conditions related to abaca growing the report discussed the possibilities of foreign competition with the local abaca industry. It stated that the danger of the possible foreign competition is not as grave as feared by many. One of the interesting facts mentioned was about the stripping of coarse grades of fiber. It was found that the strippers prefer stripping coarse grades to stripping fine grades because conditions being equal they earn more by stripping the coarse grades. However, the plantation owners lose a great deal in the stripping of coarse grades, and consequently they prefer the stripping of fine grades. So in this particular instance and under Leyte conditions the stripper gains where the planters lose and vice versa. But the planters are at the mercy of the strippers, and this explains the existence of a great amount of coarse grades in the market. This report is now very widely published. It has been published in full in the *Bureau of Commerce and Industry Journal.* It was also published in part in the *Philippines Herald* (a local daily) in its issue of May 8, 1928.

Inquiry on Tobacco Experiments

The Samson brothers who own a large tobacco hacienda in Isabela Province and engage in cigar manufacture and in selling tobacco leaf out of their own hacienda output, called at the College of Agriculture recently. They were seeking information on several features of tobacco production. They particularly wanted to know the possibility of producing locally a uniform crop of wrapper leaves and a special type of tobacco for cigarette purposes.

Professors Lava and Elayda met the visitors and showed them samples of tobacco materials that are being experimented with in both the Department of Agronomy and Department of Chemistry through their respective classes. Although this experimental work is but a part of class instruction, it has the ultimate object of helping in the solution of our pressing problems in producing locally what at present is being imported in great quantities to meet the demand of local tobacco factories.

The College faculty who are qualified are willing to coöperate with the Samson brothers or others in their enterprises, provided that they are permitted to do so by the higher authorities of the University. Messrs. Samson were furnished tobacco seeds of the varieties cultured on the College Farm, samples of which appealed to them as desirable types of wrapper tobacco and worth trying in their hacienda to secure the results in which they are interested.

EXCHANGE NOTES

Verbal understandings are poor substitutes for written contracts. Your business relations should be protected. Don't take too much for granted. Your patrons may have the utmost confidence in you and it may be agreeable to them to just let certain matters ride along, but the time may come when a written agreement will come in mighty handy. Do business in a businesslike manner always.

—*Butter, Cheese and Egg Journal* (Wisconsin).

One of the main problems with regard to the producer in the tropics and particularly with the small man is that however proficient he may be as an agriculturist he often does not reap the benefit of producing goods of first class quality. Many of the small growers and peasants sell for what they can get in the local markets to agents of trading organizations which in turn dispose of the produce after it has been graded and packed by them. The good produce, however, finds its way initially amongst the bad and

it is the trader that benefits, and not the producer, by standardizing what he has bought. . . . .

There is no single remedy that can be applied to the inefficiencies or inadequacies of the existing systems of marketing. All that can be done is to organize, applying this term in its widest sense. Growers of tropical produce should confine their attention to this word "organization," adopting, if possible, co-operative methods which would improve their standard of produce and its presentation and thereby ensure higher prices, eliminate waste in transport, handling and merchandising and regulate the quantity and quality of the produce put on the market. . . . . .

—*Tropical Agriculture.*

In California last year 81,500 acres were fumigated and 54,000 acres of citrus were sprayed for various insects at a total cost to the growers of that State of £730,000 (₱7,300,000, about), according to a statement recently made by R. S. Woglin, Entomologist of the California Fruit-growers' Exchange.

—*Journal of Agriculture* (Victoria).

Did you ever use a flashlight in your poultry work? Next time you test eggs just run a flashlight under the tray and pick out the poor ones. I test 600 eggs in less than 10 minutes. If you get up at night to look at your incubator a flashlight is handier than a match. When you go to the brooder house after dark carry a flashlight. You can throw the light on the chicks and see if they are all right and throw it off before you rouse the whole brood. A flashlight is about the handiest tool the poultry raiser can have.

—*Capper's Farmer* (Kansas).

Immediate arrest of all fruit dealers and grocers found selling immature avocados will be made..... The plea of ignorance will not be accepted by inspectors, but when immature fruit is found on a stand the avocados will be seized and held and the dealer cited to appear in court is the warning of both state and county horticultural offices. The law imposes a fine of not less than $50 nor more than $500 or six months in jail for selling or having for sale avocados having less than eight per cent of oil.

—*California Cultivator.*

America, far more so than Europe, is paying careful attention to our pleadings to encourage the cultivation of the better and best grades of cacao, and to increase consumption by lowering costs through enlarging the outputs on the estates.

—*Tropical Life.*

Three leading sugar experts have planned an aeroplane expedition to New Guinea under the auspices of the (U. S.) Department of Agriculture to seek hardier classes of sugar cane than the present American varieties. Dr. E. Brandes, a member of the sugar plant section of the Department, will fly to San Francisco shortly in a Fairchild cabin monoplane, and he will meet Dr. Jakob Peswiet, director of sugar experiments in Java for the Dutch Government. They will be joined at Hawaii by Mr. C. Pemberton (an entomologist), whose plane will be shipped to Sydney from San Francisco.

—*The Australian Sugar Journal.*

Speaking to a gathering of representative sugar producers in Brisbane recently the Premier, Mr. W. McCormack, said, in the course of a notable address, that there were very few agricultural industries in which there was such a wide distribution of the wealth produced as in the sugar industry. All sections of the community participated in the results of that great industry. It was a good wage payer. It affected transport. Of all agricultural products, sugar, though a very costly agricultural product, provided the greatest distribution of wealth in proportion to the value of the product.

—*Queensland Agricultural Journal.*

COLLEGE AND ALUMNI NOTES

On May 4, 1928, Mr. F. E. Devoto, delegate of the Ministry of Agriculture of the Argentine Republic, visited the College of Agriculture to observe the work being done in sugar cane culture and improvement and in poultry. He was accompanied by Mr. Carlos X. Burgos of the Philippine Bureau of Agriculture. The visitors were shown the cane breeding cultures and the poultry yards by Acting Dean Gonzalez, Doctor Mendiola and Doctor Fronda.

Mrs. J. R. Gillis, formerly instructor in English in this College, was a Campus visitor for a few days, in April. Mrs. Gillis is now living in Zamboanga where Mr. Gillis is engaged in the logging business.

Dr. Francisco O. Santos, until recently Acting Head of the Department of Agricultural Chemistry, was detailed by the Public Welfare Commissioner as nutrition expert to carry investigation along that line of work in several nutrition institutions of Japan during the summer recess. Doctor

Santos, accompanied by Mrs. Santos, sailed on the *S. S. President Madison* for Japan on March 31. Dr. Vicente G. Lava is in charge of the Department of Agricultural Chemistry in Doctor Santos' absence.

From April 18-20, under the supervision of Doctor Villegas and Instructor Sarao, the class studying Cattle Husbandry made a second trip for field practice to Hacienda del Rosario, Cainta, Rizal.

The class branded 52 animals, and bulls unsuitable for breeding were castrated. The students also practiced lassoing, casting, and roping of animals.

Mr. Amado Balagtas, B. S. '27, Assistant Analyst in the Chemistry Experiment Station for the last two years, has resigned to accept a position as Chief Chemist in a newly erected sugar central in Manaoag, Pangasinan. Mr. Francisco Barros, B. S. '24, has been appointed as his successor in the department.

On March 28, 1928, Mr. Vicente M. Dawis, Instructor in Agronomy in this College, was married to Miss Dolores Villanueva of Amadeo, Cavite. Miss Villanueva is a sister of Mr. Leon Villanueva, B. Agr. '20.

Mr. Getulio Guanzon, B. S. '25, temporarily in charge of the U. P. Sugar Mill, spent two weeks with the Pampanga Sugar Development Co., Inc., during the summer recess. After completing his work in the central, he left for Palawan Province for an extended vacation.

Mr. Esteban G. Collado, Instructor in Chemistry and Manager of the College Students' Mess Hall, was sent in May to Central Luzon Agricultural School at Muñoz to conduct investigation on the diet of students in that institution.

Mr. Sotero Lantican, B. Agr. '26, was a Campus visitor in May. Mr. Lantican, who has been teaching in Leon Academy, Leon, Iloilo, since graduating, spent his summer vacation visiting his parents in San Antonio, Los Baños. Mr. Lantican is the only College of Agriculture graduate from San Antonio. He has also the distinction of being the first Alumnus to contribute to the Baker Memorial Fund.